

The PCTrough Performance Model

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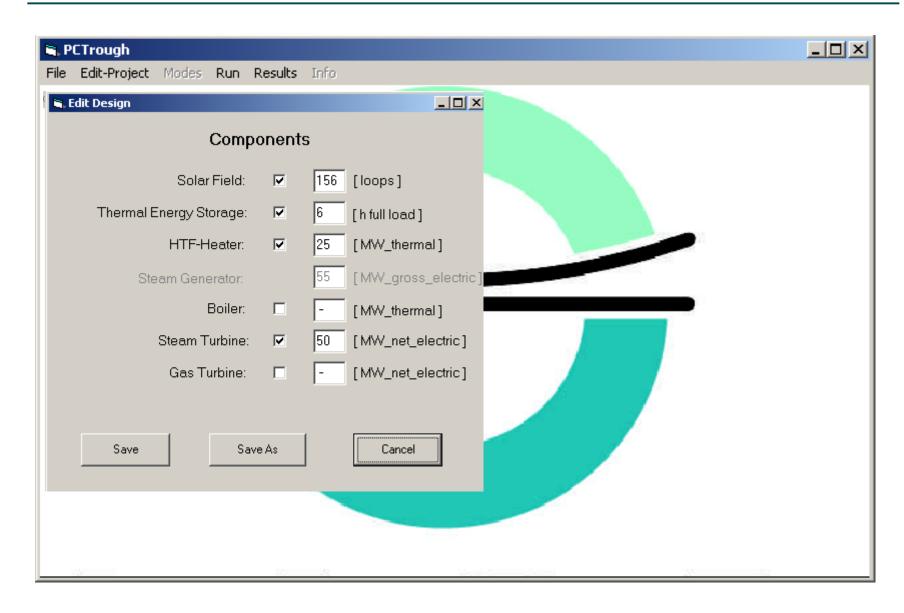
Workshop on Thermal Storage for Trough Power Systems

February 20 - 21, 2002

FLABEG Solar International GmbH

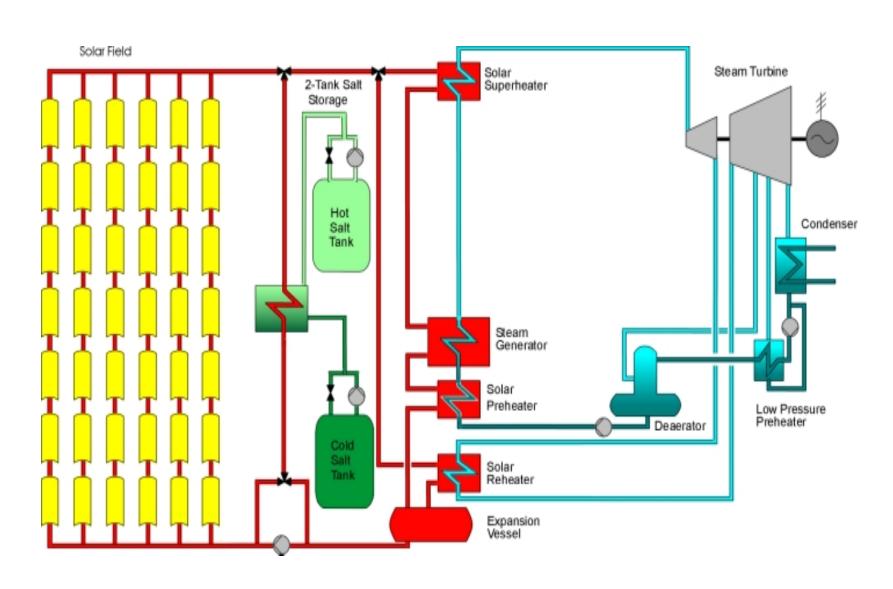
PCTrough: Plant Design Input Box





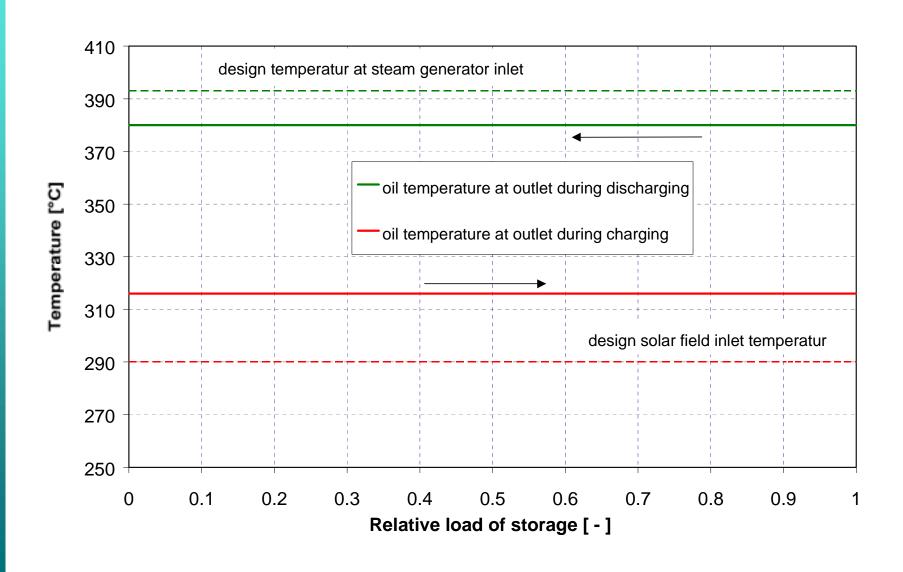
Process Scheme for SEGS plant with 2 Tank TES FLABEG





Temperature Characteristic 2 Tank System





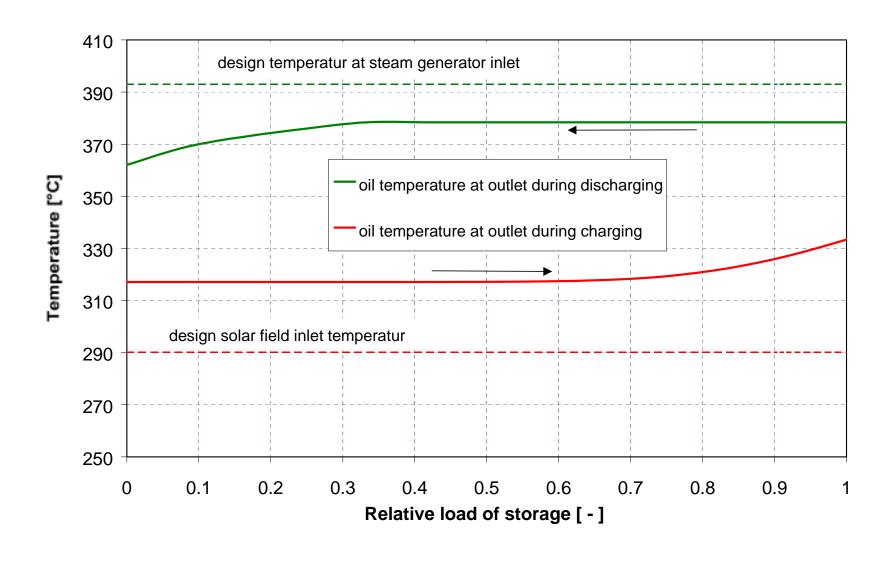
Storage Parameter Input Box



torage - Definition						
Storage Name	2-Tank Molten Salt					
Design				Status at Pro	gram Start	
Storage Medium SolerSelt		_		Temperatur of 0	Cold Tank 292	[.c]
Storage Medium	Solerseit	_		Temperatur of h	Hot Tank 292	[.c]
Design Temperatur Cold Tank		292	['C]	Load in Cold Te	ank 1	
Design Temperatur Hot Tank		384	['C]	Load in HotTa	nk 0	
Heat Losses Cold Tank		300	[kW]	Operation	_	
Heat Losses Hot Tank		360	[kW]	Charge Storage	e up to load	
DeltaT in Heat Exchanger during Charging		-7	[[0]	Discharge Storage directly to Turbine down to load 0.01		
DeltaT in Heat Exchanger during Discharging		7	['C]	_	age indirectly to Heater down to load 0.01	
Pressure Loss at Design point		776000	[Pa]	Strategy		
Mass Flow at Design point (Fraction of Solar Field Mass Flow)		50	[%]	© Demand	Optimized	
		80			Charge Storage up to relative Load before Start-up of Turbine	
Pump Efficiency		Inn	[%]		except in Summer from Month	
				Solar Field F	reeze Protection by Storage	
	Save	1	Saw	e As	Cancel	

Temperature Characteristic Thermocline TES





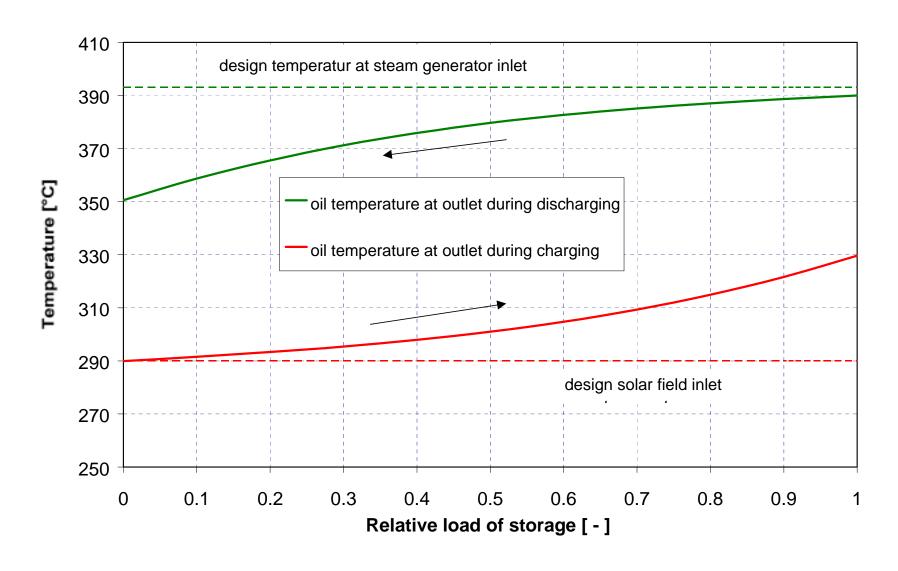
Storage Parameter Input, Thermocline



Storage - Definition	
Storage Name Salt-Thermocline	
Design	Status at Program Start Temperatur of Tank 283 [*C]
Design Temperatur Cold Design Temperatur Hot Tank Heat Loss DeltaT in Heat Exchanger during Charging DeltaT in Heat Exchanger during Discharging DeltaT in Heat Exchanger during Discharging DeltaT in Heat Exchanger during Discharging C0 = 0.9138	Storage Load Operation Charge Storage up to load Discharge Storage directly to Turbine down to load Discharge Storage indirectly to Heater down to load Strategy Optimized Charge Storage up to relative Load before Start-up of Turbine except in Summer from Month
Save	Save As Cancel

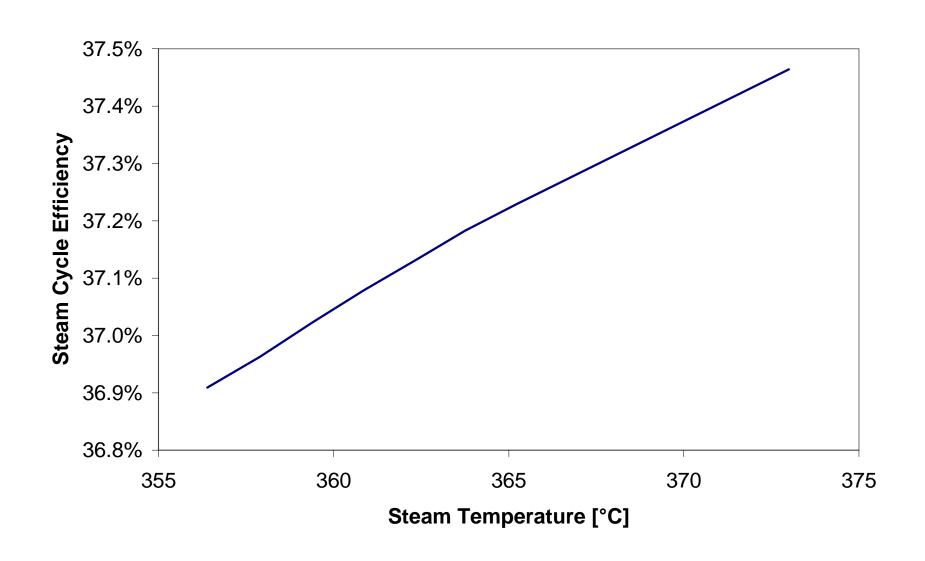
Temperature Characteristic Concrete Storage





Steam Cycle Efficiency





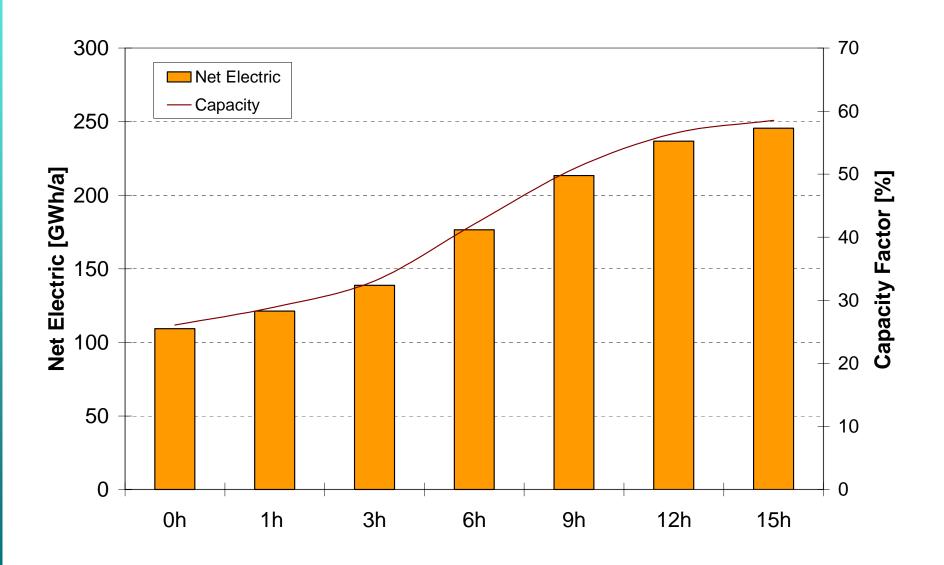
Steam Turbine Input Parameter



🖷 Steam Tubine	_						
Steam Turbine Parameter							
Name and Manufacturer: 50MWgr, ABE	3						
Maximum Electric Power, gross : /is no longer weed/	55 [MW]						
Minimum Electric Power:	5 [MW]						
Efficiency for different operation modes :							
Operation from Solar Field :	37.46 [%]						
Operation from Boiler :	0 [%]						
Operation from WHRS :	0 [%]						
Efficiency as a function of steam turbine los c0: 0.76471 c1: 0.60635 c2: -0.59279	ed: c3: 0.22218 c4: 0						
Efficiency as a function of temperature :							
c0: 0.3665 c1: 1.2471 c2: -0.6141	c3: 0 c4: 0						
Start-Up time : Energy needed for Start-Up :	45 [min] 120 [MWh]						
Save Save As	Cancel						

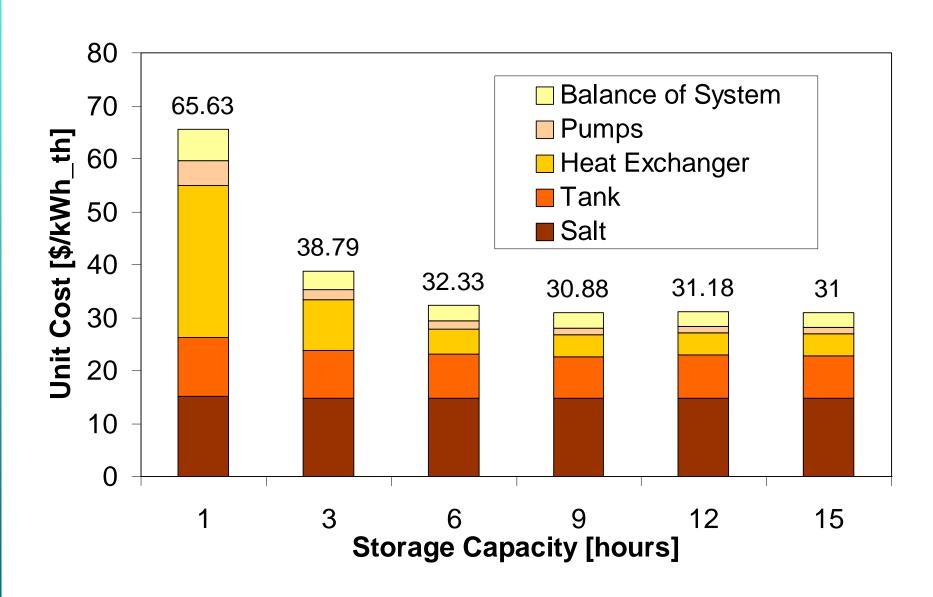
Performance Results





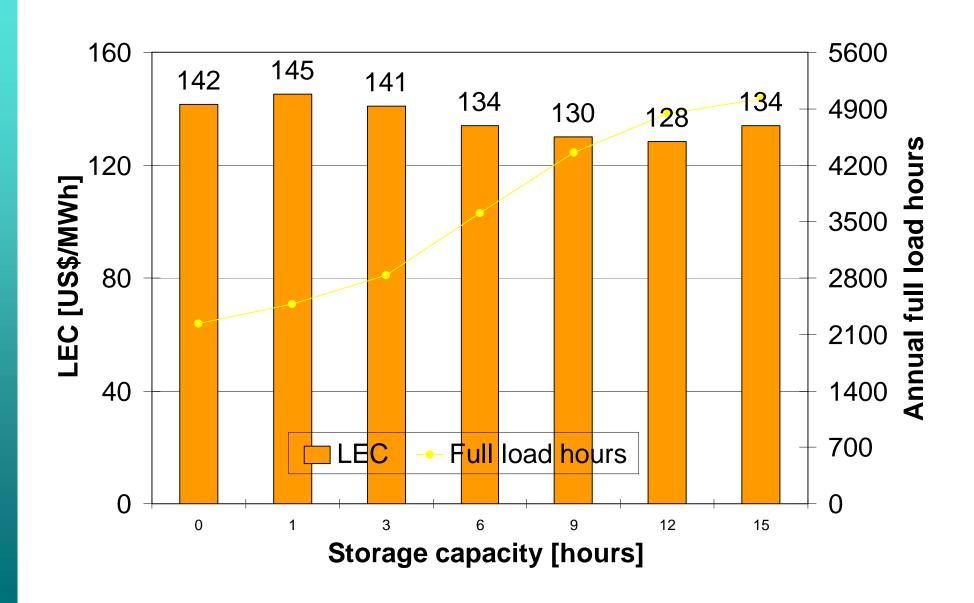
2-Tank Storage, Investment Cost





Results of Modelling





Summary



- Accurate performance analysis of trough plants with integrated thermal storage requires a detailed modelling of:
 - Temperature characteristic of storage during charging and discharging
 - Heat exchanger part load performance
 - Steam cycle part load performance
- The subsystems (Storage and Steam Cycle) have to be modelled with suitable tools
- The PCTrough performance model is able to combine and process the modelling results
- This includes also storage for ISCCS plants